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THE BRYOLOGIST.

VOL. VII.

NOVEMBER, 1904.

No. 6.

FURTHER NOTES ON CLADONIAS.—IV.

Cladonia verticillata.

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Tuckerman included *Cladonia verticillata* as a variety of *Cladonia gracilis*, but it is apparent enough that the plants that Tuckerman included in the variety are quite distinct from the others commonly placed under the species last named above. *Cladonia gracilis* is an exceedingly variable lichen, and it is doubtless true, as first appeared to the present writer after studying the forms found in northern Minnesota several years ago, that some European lichenists have carried the splitting process to extremes in their disposition of this species. The great degree of variation in the species is further shown in some very interesting forms that have come to me in the last few months, collected in New England by Mr. G. K. Merrill, and especially in that famous collecting ground in the White Mountains including "Tuckerman's Ravine." Also Mrs. Carolyn W. Harris has found some interesting forms in the Adirondacks.

But it seems best in disposing of *Cladonia verticillata* and *Cladonia gracilis* to dispose of the former species first as it is much easier to understand, and a presentation of figures and descriptions of the latter will form the basis of the next paper of this series. During the summer just passed, Dr. E. L. Harper, of Chicago, obtained some excellent photographs of lichens on Isle Royale in Lake Superior, and among the number were four or five of the two closely related species which are to receive attention in the present and the next following paper. I am under obligations to Dr. Harper for the photographs from which the illustrations in the present paper are taken. As readers of this series of papers are doubtless aware, it is not easy to bring out the characters of *Cladonias* in illustrations, but if the cuts can be made to bring out what is shown in the photographs, we shall succeed better than formerly. Then in the paper on *Cladonia gracilis*, we will be fortunate in being able to use photographs taken by Mr. Merrill from plants found in the region which has thus far proved richest in forms of *Cladonia gracilis*. In the present paper is given a most excellent likeness of *Cladonia glacilis dilatata*, Plate XI, Fig. 3, from a photograph by Dr. Harper, the object being to bring out the differences between the two closely related species.

Again we are able to have Dr. Wainio's view of a large number of specimens of the two species to be considered in this and the next paper. This is particularly fortunate regarding the various forms of *Cladonia gracilis*, the species to be disposed of in the present paper being far more easily understood as soon as one learns to distinguish it from the species named above.

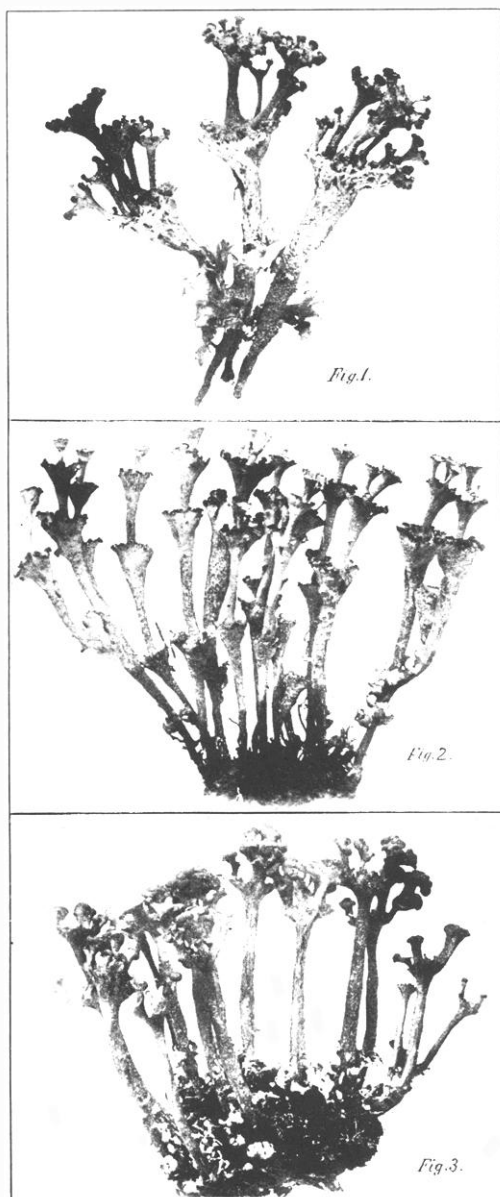


PLATE XI. Fig. 1. *Cladonia verticillata*. Fig. 2. *C. verticillata* var. *evoluta*. Fig. 3. *C. gracilis* var. *dilatata* $\times 1$.

Regarding the known distribution of *Cladonia verticillata*, we shall be able to make more definite statements than have been given concerning most of the *Cladonias* disposed of in previous papers. This is due to the fact that collectors and students have usually found the plant, and have not confused it with others so frequently as many other *Cladonias*. Indeed, one may depend on the lists of species published in the various states, for the distribution of this species, with a considerable degree of certainty. Yet we shall depend upon material actually seen, or the lists of a few lichenists of unquestionable ability. However, it is always unfortunate that a large amount of material in various herbaria can not be examined for the sake of additions to distribution. Finally, the forms of the species are not so numerous as in many *Cladonias*, and it is hoped that with the figures and the descriptions to follow, students of the *Cladonias* will have little further trouble with this species, except possibly the last two varieties, which are very rare. These we can not figure.

CLADONIA VERTICILLATA Hoffm. Deutschl. Fl. 2:122. 1796. Plate XI.
Fig. 1.

Primary thallus commonly persistent, composed of irregularly subcuneate, crenately lobed, or even incised-lobate, flat or somewhat involute, ascending, clustered or scattered, medium sized or larger squamules, which are 1.5-7.5 mm. long and wide, sea-green above or more commonly varying toward ashy, olivaceous or brownish, below white or darkening toward the base. Podetia arising from the lower margin of the squamules, 3-55 mm. long and .5-3.5 mm. in diameter, tubeaform or more rarely turbinate, subsolitary or clustered into small patches, erect or rarely ascending, subcontinuous, grooved or areolate, with areoles usually closely contiguous, destitute of squamules, or rarely more or less squamose toward the base of the podetia or at the margins of the cups, sea-green varying toward ashy, yellowish, brownish, or olivaceous or these colors variegated, the narrow decorticate portions between the areoles white or rarely reddish, scyphiform. Cups medium sized or large, 2.5-9 mm. in diameter, usually abruptly dilated, shallow, the bottom closed or rarely cribose, the margin subentire or dentate, commonly proliferous from the cavity of the cup, the proliferations one to several and the ranks usually two to five, the lowest rank about 20 mm long. Apothecia small or medium-sized, .5-2.5 mm. in diameter, rounded or irregular, sometimes perforate, sessile on the margins of the cups, or short-pedicellate, flat and thinly margined or becoming convex and immarginate, paler or darker brown. Hypothecium pale or cloudy. Hymenium commonly pale below and brownish above. Paraphyses simple or rarely branched, commonly thickened and brownish toward the apex.

Found on various soils, both in shaded and open places, and frequently on thin soil over rocks or on decaying wood. Generally distributed throughout North America, except perhaps the extreme north and south; but more common or larger northward or in the mountains southward. Examined from several localities in New England and New York, and from Pennsyl-

vania, Maryland, West Virginia, New Jersey, Ohio, Illinois, Iowa, Minnesota, Michigan, California, Missouri, Tennessee, Louisiana, Alabama, Florida, Newfoundland and several localities in British America. Macoun's "Catalogue of Canadian Plants" gives a wide distribution in British America. Also Clara E. Cummins has examined the plant from Alaska. Neither Tuckerman nor Wainio adds to this distribution. The specimens seen were collected by W. G. Farlow, Henry Willy, Clara E. Cummings, G. K. Merrill, E. A. Burt, Carolyn W. Harris, J. C. Eckfeldt, Emily Eby, T. A. Williams, H. A. Green, E. E. Bogue, Bruce Fink, E. L. Harper, H. E. Hasse, Colton Russell, W. W. Calkins, A. C. Waghorne and John Macoun. Known in all the grand divisions.

CLADONIA VERTICILLATA EVOLUTA Th. Fr. Lich. Scand. 83. 1871. Plate XI.
Fig. 2.

Primary thallus commonly of smaller squamules. Podetia becoming elongated and consisting of several ranks, in ours commonly four to six.

Examined by Dr. Wainio from my material from Minnesota, where the variety is distributed throughout the northern portion of the state. Habitat as above. Elsewhere examined by me from Isle Royale in Lake Superior; collected by Harper and figured herein; from Maine, collected by Merrill, from New Jersey, collected by Green; from the Adirondack mountains, collected by Mrs. Harris; and from Miquelon Islands, collected by Delamare. Nothing further can be definitely stated regarding the distribution of the variety, but it is probably common enough northward and in the mountains southward, and elsewhere in North America rare or absent. But we judge from Wainio's sequence of diagnoses and descriptions that he would give this form a general North American and foreign distribution.

CLADONIA VERTICILLATA CERVICORNIS (Ach.) Flk. Clad. Conn. 29. 1828.

Primary thallus persistent, composed of rather large or medium-sized, usually densely clustered, laciniate squamules, which are about 5–12 mm. long. Podetia rather short and slender for the species, 2–20 mm. long and .3–1 mm. in diameter, simple or proliferous from the central portions of the cups, or rarely from the margins or even from the sides of the podetia below the cups, the ranks 1–3, the upper ranks often without cups and branched irregularly, without squamules or squamose about the margins of the cups.

On humus among rocks or stones or in windy and sunny dry places, The only undoubted specimens seen are those collected in Germany by H. Sandstede and sent to me by the late Dr. F. Arnold, of München. However, another from our own country sent from Bay St. Louis, Mississippi, by A. B. Langlois and placed in the species by Hue, seems to be the variety. The whole plant is small, but the squamules are large in proportion, the proliferations from the sides of the podetia frequently seen, and more rarely fruited ones from the margins of the cups. Wainio credits this form to Greenland, Arctic America, New Bedford and the White Mountains. Known in all the grand divisions. "Fere sicut *ovoluta* distributa est sed ravior," Wainio says. Wainio also states that his *Cladonia verticillata subcervicornis* Wainio

Mon. Clad. Univ. 2:197. 1894, has occurred in Greenland. This is a smaller plant with shorter podetia, smaller squamules, one-or-two-ranked, and without squamules or proliferations on the podetia or the margins of the cups. We judge from Wainio's description that it is perhaps but an immature condition of var. *cervicornis*, and shall give it no separate description here.

CLADONIA VERTICILLATA ABBREVIATA Wainio Mon. Clad. Univ. 2:197. 1894.

Primary thallus persistent, composed of smooth, lacinate, medium-sized squamules, which are 2-4 mm. long. Podetia arising from the upper surface or rarely from the margins of the squamules, about 1-1.5 mm. long and .3-.5 mm. in diameter, without cups and always terminated by apothecia, simple and without squamules, the cortex subcontinuous or rarely becoming areolate. Apothecia small, about 1-1.5 mm. in diameter, solitary or rarely aggregated at the summit of the podetium, flat and indistinctly margined by an exciple, or becoming convex and immarginate, brown or blackish brown.

On sandy earth. Wainio bases the variety upon material sent from New Bedford, Mass., by Henry Willey, and states that it passes into the normal form of the species. This variety is not known elsewhere, and I have not been able to examine it. However, if found elsewhere, there will be no difficulty in distinguishing it as it will probably occur in same environment with one of the better known forms of the species.

Cladonia gracilis, being the species with which the forms of *Cladonia verticillata* have sometimes been placed and with which they are easily confused, it has been thought best to give Plate XI, Fig. 3, Harper's excellent photograph of an average form from Isle Royale. The description will appear in the next paper of this series, and it is only necessary in closing this one, to give a few of the points of differences in the two species. In *Cladonia gracilis*, squamules are to be looked for anywhere on the podetia, while in *Cladonia verticillata*, they occur only at the base or on the margins of the cups. As a whole the podetial squamules are quite rare in the latter species, but common enough in the former. Also in the latter the proliferations are almost always from the central portions (or cavity) of the cup, while in the former they are nearly always from the margins. Without further differentiation, these may be regarded as the "ear marks" by which the two species may be distinguished. Other differences are less marked and are difficult to bring out even in the best descriptions.

Dr. Harper used excellent judgment in selecting and placing his specimens for photographing. It will be noted that they are all fruited, and it is to be hoped that the areoles and the decorticate lines between them will come out in the figures as well as they do in his likeness of var. *evoluta*.

Grinnell, Iowa.